Glider Observations of Circulation Around an Island

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LONG-TERM GOALS

A continuing interest in oceanographic research involves the observation and prediction of coastal circulation. A special branch of the coastal problem involves circulation around islands, which has been less studied over the years. Island circulation is distinguished from continental coastal circulation primarily by an island's small size relative to the scales of atmospheric forcing and general ocean currents. Relevant processes include boundary currents, eddies shed in the island's wake, and island coastally trapped waves. This project aims to improve the understanding of island circulation through observations using underwater gliders, with the ultimate goal of better prediction.

OBJECTIVES

Given a goal of quantifying island circulation, a sensible approach is to address the hierarchy of issues. The steady circulation around an island is a result of the large-scale wind field, and the oceanic general circulation in which the island is embedded. First, we plan to address the so-called "island rule" (Godfrey, 1989) which supposes flow on the east side of the island is due to the integral effect of wind stress curl to the east of the island across the entire ocean basin. Second, we will address the effects of local wind may also force boundary currents on all sides of islands. Third, we expect wakes of eddies given that islands are often embedded in a larger-scale flow. Finally, we will examine the possibility of quantized coastally trapped waves, as imposed by the requirement that an integral number of wavelengths equal the distance around the island.

APPROACH

We will make Spray glider observations from Palau to resolve the phenomena described above. We have extensive experience deploying gliders from Palau as part of the Origins of the Kuroshio and Mindanao Current project, making for convenient logistics. Palau is embedded in strong globally important currents, with the westward North Equatorial Current to the north and the eastward North Equatorial Counter Current to the south. Because of this unique location, Palau is an ideal laboratory for studying the complete suite of island circulation effects.

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WORK COMPLETED

The major event of year 1 was a cruise led by Shaun Johnston on the Revelle in July. The cruise made a series of surveys of bottom topography, temperature, salinity, and currents around islands in Palau. Our role in this cruise was to support its objectives with glider observations. Towards this end, one glider occupied a station off the west coast of Babeldaob for 3 weeks, and a second glider made repeated sections off the channel between Peleliu and Angaur for 5 weeks. These data will be analyzed in conjunction with the survey data from the cruise.

Work has begun on analyzing previous observations around the islands from gliders, temperature recorders on the reefs, and meteorological stations. A focus has been the on the effects of typhoon Bopha, which hit Palau in December 2012.

RESULTS

Preliminary results from the analysis of the effects of Bopha suggest a coastally trapped storm surge that caused strong upwelling, and travelled around the island (Figure 1). Analysis of temperture records at reefs around the island support this hypothesis.

IMPACT/APPLICATIONS

All temperature and salinity data from gliders is being sent to NAVO in real time for assimilation into operational models.

RELATED PROJECTS

This project has benefitted directly from the logistical support established by the Origins of the Kuroshio and Mindanao Current (OKMC) DRI. OKMC gliders took relevant observations as they awaited recovery off the coast of Palau, and these data helped to form the hypotheses that motivate this project.

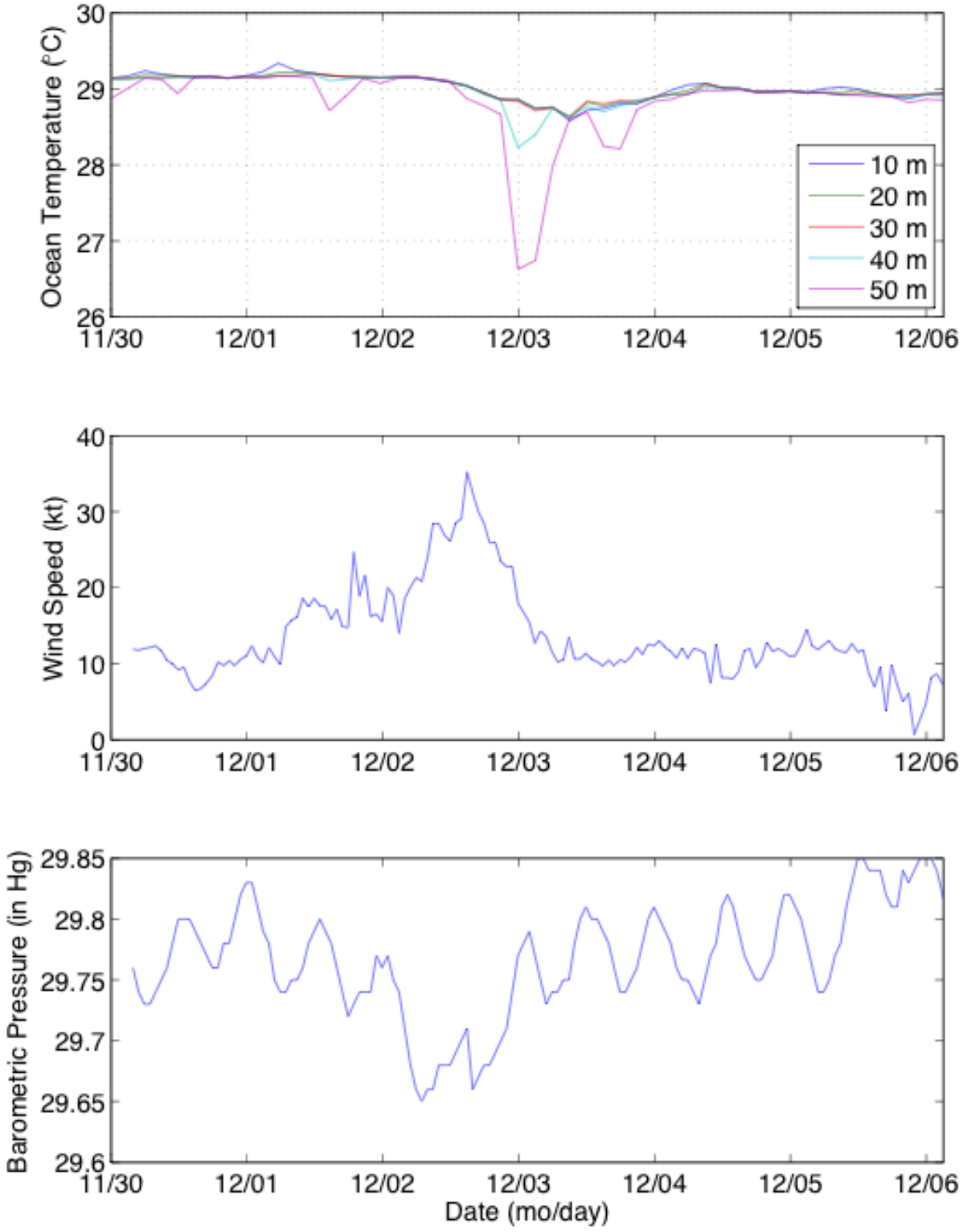

Figure 1. Time series from (top) a glider occupying a station off the west coast of Palau, and (middle) wind speed, and (bottom) barometric pressure from a meteorological station on the island. The cooling on December 3, 2012 was likely caused by an internal storm surge travelling along the coast.